

**OROVILLE FERC RELICENSING  
(PROJECT No. 2100)**


**INTERIM REPORT  
SP-F3.2 TASK 2  
SP-F21 TASK 1**

**APPENDIX A  
MATRIX OF LIFE HISTORY AND HABITAT REQUIREMENTS FOR  
FEATHER RIVER FISH SPECIES**

**LITERATURE REVIEW OF LIFE HISTORY AND  
HABITAT REQUIREMENTS FOR  
FEATHER RIVER FISH SPECIES**

**SACRAMENTO SUCKER**

**JANUARY 2003**

Element	Element Descriptor	General	Feather River Specific
<b>General</b>			
common name (s)	English name (usually used by fishers and laypeople).	Sacramento sucker	
scientific name (s)	Latin name (referenced in scientific publications).	<i>Catostomus occidentalis</i>	
taxonomy (family)	Common name of the family to which they belong. Also indicate scientific family name.	Suckers - <i>Catostomidae</i>	
depiction	Illustration, drawing or photograph.		
range	Broad geographic distribution, specifying California distribution, as available.	<p>Common and widely distributed in central and northern California. In the Sacramento-San Joaquin drainage it occurs in streams and reservoirs from the upper Goose Lake basin in Oregon to the upper Kern River in the San Joaquin-Tulare drainage (Moyle 2002).</p> <p>Sacramento suckers are generally distributed in the tributaries of the Sacramento-San Joaquin River system. They are specifically located below Nimbus Dam and in the vicinity of Sailors Bar Park of the American River; in lower reaches of Capell Creek of Lake Berryessa; at Glen Ellen on Sonoma Creek; in upper Corte Madera Creek; in San Pablo Creek; in upper Alameda Creek; in upper Walnut Creek; and in San Ramon Creek. Spawning also occurs in the upper San Joaquin River at Millerton Lake, in a tributary of Union Valley Reservoir, and the Rubicon River (Wang J. 1986).</p>	
native or introduced	If introduced, indicate timing, location, and methods.	Sacramento suckers are native to California (Wang J. 1986).	

Element	Element Descriptor	General	Feather River Specific
ESA listing status	Following the categories according to California Code of Regulations and the Federal Register, indicate whether: SE = State-listed Endangered; ST =State-listed Threatened; FE = Federally listed Endangered; FT = Federally-listed Threatened; SCE = State Candidate (Endangered); SCT = State candidate (Threatened); FPE = Federally proposed (Endangered); FPT = Federally proposed (Threatened); FPD = Federally proposed (Delisting); the date of listing; or N = not listed.	Sacramento sucker is not a listed species.	
species status	If native, whether: Extinct/extirpated; Threatened or Endangered; Special concern; Watch list; Stable or increasing. If introduced, whether: Extirpated (failed introduction); highly localized; Localized; Widespread and stable; Widespread and expanding.	Sacramento sucker is described as stable and increasing. The Sacramento sucker is one of the few species of native fishes that has thrived despite massive changes to California's waterways (Moyle 2002).	
economic or recreational value	Indicate whether target species sought for food or trophy. Whether desirable by recreational fishers, commercial fishers, or both.	They are edible but are not often sought after by fishermen (Wang J. 1986).	
warmwater or coldwater	Warmwater if suitable temperature range is similar to basses; coldwater if suitable temperature range is similar to salmonids.	Sacramento suckers exhibit a wide ranges of water temperature tolerances. They can be found in streams where temperatures rarely exceed 59°F-60.8°F (15°C-16°C) and in streams where temperatures may reach 84.2°F-86°F (29°C-30°C). Preferred temperatures appear to be approximately 68°F-77°F (20°C-25°C), which may be optimal for growth (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
pelagic or littoral	Environment: Pelagic - living far from shore; Littoral - living near the shore.	Sacramento suckers are found in a wide variety of water from cold, rapidly flowing streams to warm sloughs to low-salinity sections of the San Francisco Estuary. They are most abundant in clear, cool streams and rivers and in lakes and reservoirs at moderate elevations (Moyle 2002)	
bottom or water column distribution	Environment: bottom (benthic) or along water column.	<p>Benthic.</p> <p>Sacramento suckers are found in nearly continuous contact with the bottom (Moyle et al. 1985).</p> <p>Different sizes of Sacramento sucker are found in different microhabitats. Larval suckers concentrate over detritus bottoms or along emergent vegetation in warm, protected stream margins. Juvenile suckers stay on or close to the bottom foraging in shallow, slowly flowing water along stream margins. Smaller fish seek the shallowest water. In the absences of predators, such as pikeminnow, juvenile suckers use deeper water. During the day subadult and adult suckers are usually found in deep-water pools and runs or beneath undercut banks near riffles. Large suckers seek areas where they are relatively safe from avian predators (heron, osprey) and where stream velocities are less than 1.3 ft/sec (40 cm/sec). In clear streams large suckers are mostly found either in deep cover or in deep pools during the day (Moyle 2002).</p>	
lentic or lotic	Environment: Lentic - pertaining to stagnant water, or lake-like; Lotic - moving water, or river-like.	<p>Small foothill streams serve as nursery areas while the adults live in larger streams and reservoirs (Moyle et al. 1974).</p> <p>Adults are most numerous in larger streams; juveniles are often most abundant in tributary streams or shallow reaches of large rivers where adults have spawned (Moyle 2002).</p>	
<b>Adults</b>			
life span	Approximate maximum age obtained.	Sacramento suckers can live to be 30 years old, and it is likely that many suckers over 15.7 inches (400 mm) are considerably older than 10 years of age (Moyle 2002).	
adult length	Indicate: Length at which they first reproduce; average length and maximum length the fish can attain.	Growth in Sacramento suckers is as variable as their habitats. Fish at first maturity (usually ages 4-6) range from 7.9 to 12.6 inches (200 to 320 mm) FL, depending on stream and reservoir. In the North Fork Feather River, where it was unlikely that any suckers were older than 10 years, 7- to 10-year old fish measured 13.8-16.5 inches (350-420) mm FL, and age size relationship consistent with that reported from other studies (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
adult weight	Indicate: Weight at which they first reproduce; average weight and maximum weight the fish can attain.		
physical morphology	General shape of the fish: elongated, fusiform, laterally compressed, etc.		
coloration	Indicate color, and color changes, if any, during reproduction phase.	Adults tend to be greenish to brown on the back and dusky yellow-gold to white on the belly. Spawning fish develop a dark stripe on the sides, which is lined with or is entirely dark red, especially on spawning males. Young suckers are gray all over, slightly darker on top, with 3-4 poorly defined splotches on the sides (Moyle 2002).	
other physical adult descriptors	Unique physical features for easy identification.	Sacramento suckers are "typical" suckers, with subterminal mouths and large fleshy lips covered with papillae (4-6 rows on the upper lip) (Moyle 2002).	
adult food base	Indicate primary diet components.	Adult feed primarily on algae, detritus, and small invertebrates associated with the bottom. In Thomas Creek (Tehama County) the digestible portion of the gut contents of adults ranged from 50% (by volume) invertebrates in the winter to 1-12% invertebrates at other times of the year; the remainder was detritus and algae. In Hat Creek (Shasta County) sucker exceeding 15.7 inches (40 cm) in length had gut contents which were 40% algae (mostly diatoms), with the remainder of the gut content consisting of invertebrates such as chironomid and caddisfly larvae (Moyle 2002).	
adult feeding habits	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder.	Suckers often occur in small, loose groups of foraging fish. Feeding can be an almost continuous activity, but usually suckers are most active at night. In streams adults spend the day browsing or resting on the bottom of deep pools or in flowing areas with strong surface turbulence, moving up into riffles to forage in the evening. In lakes they spend daylight hours in fairly deep water, moving into shallows to feed at night. Feeding activity is greatly reduced during the colder months of the year (Moyle 2002).	
adult in-ocean residence time	For anadromous species, age when they migrate to the ocean and duration spent in the ocean before returning to freshwater to spawn.	N/A	

Element	Element Descriptor	General	Feather River Specific
adult habitat characteristics in-ocean	For anadromous species, description of the ocean habitat utilized: whether along major current systems, gyres, pelagic (beyond continental shelves) and neritic (above continental shelves) zones, etc.	N/A	
<b>Adult upstream migration (immigration)</b>			
range of adult upstream migration timing	Time of year adults migrate upstream. If applicable, indicate for various runs.	<p>Sacramento suckers may migrate to a spawning stream, typically a tributary to a large river or reservoir, prior to spawning. They may start moving into spawning streams as early as late December. In Pine Flat Reservoir (located in Fresno County), the immediate trigger for spawning runs appeared to be sudden warming of inflowing creeks following a series of warm days, although increases in flow were also implicated (Moyle 2002).</p> <p>Sacramento sucker are potamodromous, migrating from large bodies of fresh water to streams for spawning (Wang J. 1986).</p>	
peak adult upstream migration timing	Time of year most adults migrate upstream. If applicable, indicate for various runs.		
adult upstream migration water temperature tolerance	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	During a 5 year period, migration to spawning tributaries began at water temperatures ranging from 42.1°F to 51.1°F (5.6°C to 10.6°C). A sudden cooling spell halted migration until the water warmed up again (Moyle 2002).	
adult upstream migration water temperature preference	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.		
<b>Adult holding (freshwater residence)</b>			
water temperature tolerance for holding adults	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Sacramento suckers exhibit a wide ranges of water temperature tolerances. They can be found in streams where temperatures rarely exceed 59°F-60.8°F (15°C-16°C) and in streams where temperatures may reach 84.2°F-86°F (29°C-30°C). Preferred temperatures appear to be approximately 68°F-77°F (20°C-25°C), which may be optimal for growth (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
water temperature preference for holding adults	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.		
water depth range for holding adults	Reported range of observed (minimum and maximum) water depth utilization.		
water depth preference for holding adults	Reported range of most frequently observed water depth utilization.		
substrate preference for holding adults	If bottom dwellers, indicate substrate: mud, sand, gravel, boulders, aquatic plant beds, etc. If gravel, indicate range or average size of gravel.		
water velocity range for holding adults	Reported range of observed (minimum and maximum) water velocity utilization.	Large suckers seek areas where stream velocities are less than 1.3 ft/sec (40 cm/sec) (Moyle 2002).	
water velocity preference for holding adults	Reported range of most frequently observed water velocity utilization.		
other habitat characteristics for holding adults	General description of habitat (e.g. turbid or clear waters, lentic or lotic, presence of aquatic plant beds, debris, cover, etc.).	Subadult and adult Sacramento sucker are usually found in the deep water of pools and runs or beneath undercut banks near riffles during the day. In clear streams, large Sacramento suckers are mostly found either in deep cover or in deep pools during the day (Moyle 2002).	
timing range for adult holding	Time of year (earliest-latest) and duration of stay from upstream migration to spawning.		
timing peak for adult holding	Time of year when maximum number of adults are present before spawning.		
<b>Spawning</b>			
fecundity	Average or range in the number of eggs females lay in a spawning season.	Fecundity ranges from 4,700-11,000 eggs/female for fish ranging from 11-15 inches (28-38 cm) FL (Moyle 2002; Wang J. 1986).  In Thomas Creek, females measuring 12.6-18.9 inches (32-48 cm) FL	

Element	Element Descriptor	General	Feather River Specific
		contained 10,300-32,000 eggs (Moyle 2002).	
nest construction	Location and general description of nest -- substrates, aquatic plants, excavations, crevices, habitat types, etc.	NA	
nest size	Size and average dimensions of the nest.	NA	
spawning process	Indicate whether nest builder, broadcast spawner, or other.	<p>During spawning, each female, accompanied by several males, deposits eggs over a gravel substrate (Wang J. 1986).</p> <p>Large numbers of Sacramento sucker gather in a spawning area, with each spawning female accompanied by 2-7 males. Vigorous splashing during spawning by both males and females creates a slight depression in the gravel substrate. The lead fish (the female) starts to tremble and dip downward, compressed between 3 or 4 of the following males. When the group hits bottom, eggs and sperm are released, and the water around the suckers becomes cloudy with a puff of brown silt, which drifts downstream (Moyle 2002).</p>	
spawning substrate size/characteristics	Range of substrates used during spawning (e.g. mud, sand, gravel, boulders, beds of aquatic plants). Indicate presence of plant/wood debris, crevices at spawning sites. If gravel, indicate range of average size.	<p>Spawning occurs in streams or rivers with sand, gravel, or cobble bottoms (Wang J. 1986).</p> <p>Most spawning takes place over gravel riffles (Moyle 2002).</p>	
preferred spawning substrate	Indicate preferred spawning substrate (e.g. mud, sand, gravel, boulders, plant bed, etc).		
water temperature tolerance for spawning	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Spawning migration begins at water temperatures ranging from 42.1°F to 51.1°F (5.6°C to 10.6°C) (Moyle 2002), while actual spawning occurs at water temperatures ranging from 53.6°F-63.5°F (12°C-17.5°C) (Wang J. 1986).	
water temperature preference for spawning	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		

Element	Element Descriptor	General	Feather River Specific
water velocity range for spawning	Minimum and maximum speed of water current the spawning fish can tolerate.		
water velocity preference for spawning	Preferred water current (flow velocity) during spawning.		
water depth range for spawning	Reported range of observed (minimum and maximum) water depth utilization.	Water depth of 11.8 inches (30 cm) or more is suitable for spawning Sacramento suckers (Moyle 2002).	
water depth preference for spawning	Reported range of most frequently observed water depth utilization.		
range for spawning timing	Earliest and latest time of season or year in which spawning occurs.	Most spawning takes place between late February and early June, although the presence of larval suckers in mid-August in the Russian River and other coldwater streams suggests that spawning may occur as late as early August (Moyle 2002).	
peak spawning timing	Time of year most fish start to spawn.	Peak spawning usually occurs in March and April (Moyle 2002).	
spawning frequency (iteroparous/semelparous)	Semelparous - producing all offspring at one time, such as in most salmon. Usually these fish die after reproduction. Iteroparous - producing offspring in successive, e.g., annual or seasonal batches, as is the case in most fishes.	Sacramento sucker are iteroparous. Individual females may spawn in as many as 7 years (Moyle 2002).	
<b>Incubation/early development</b>			
egg characteristics	Shape, size, color, in clusters or individuals, stickiness, and other physical attributes.	Eggs are spherical or slightly irregular and adhesive. They are deposited singly or in small clusters in the nest. Sacramento sucker eggs are demersal and sink into interstices of the gravel (Wang J. 1986).	
water temperature tolerance for incubation	Range of water temperatures allowing survival. Indicate stressful or lethal levels.		
water temperature preference for incubation	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		

Element	Element Descriptor	General	Feather River Specific
time required for incubation	Time duration from fertilization to hatching. Note: Indicate at which temperature range. Incubation time is temperature-dependent.	The eggs settle into the gravel and adhere on the substrates, and the incubation period ranges from 3-4 weeks. Newly hatched larvae usually remain on the bottom within the interstices of the gravel until the yolk sac is absorbed (Wang J. 1986).  Embryos hatch in 2-4 weeks, and the larvae remain in or among the gravel (Moyle 2002).	
size of newly hatched larvae	Average size of newly hatched larvae.	Newly hatched larvae range in total length from 0.39-0.44 inch (10-11.3 mm) (Wang J. 1986).	
time newly hatched larvae remain in gravel	Time of year of hatching, and duration between hatching and emergence from gravel.	Newly hatched larvae usually remain on the bottom within the interstices of the gravel until the yolk sac is absorbed (Wang J. 1986).	
other characteristics of larvae	Alevin -- early life history phase just after hatching (larva) when yolk-sac still present.		
timing range for emergence	Time of year (earliest-latest) hatchlings (larvae and alevins) leave or emerge from the nesting/hatching (gravel) sites.		
timing peak for emergence	Time of year most hatchlings emerge.		
size at emergence from gravel	Average size of hatchlings at time of emergence.	At completion of the yolk-sac stage, Sacramento sucker range in total length from 0.5-0.6 inches (12.0-14.5 mm) (Wang J. 1986).	
<b>Juvenile rearing</b>			
general rearing habitat and strategies	General description of freshwater environment and rearing behavior.	Postlarval and small juvenile suckers may move from spawning tributaries downstream at lengths ranging from 0.4-1.2 inches (10-30 mm) FL. However, in some spawning streams, juveniles will spend 2-3 years in the spawning stream prior to moving downstream to a large river or reservoir during high flows (Moyle 2002).	
water temperature tolerance for juvenile rearing	Range of water temperatures allowing survival. Indicate stressful or lethal levels.		
water temperature preference for juvenile rearing	Range of suitable, preferred, or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		

Element	Element Descriptor	General	Feather River Specific
water velocity ranges for rearing juveniles	Reported range of observed (minimum and maximum) water velocity utilization.	As postlarvae, Sacramento sucker emerge into the water column and will be found in moderate running water and side pools (Wang J. 1986).	
water velocities preferred by rearing juveniles	Reported range of most frequently observed water velocity utilization.	Juvenile suckers of less than 1.97 inches (50 mm) SL use slowly flowing water (less than 0.3 ft/sec [10 cm/sec]) along the stream margin (Moyle 2002).	
water depth range for juvenile rearing	Reported range of observed (minimum and maximum) water depth utilization.	Smaller fish seek the shallowest water (Moyle 2002).  Juvenile suckers of less than 1.97 inches (50 mm) SL stay on or close to the bottom, foraging in shallow water at depths of 7.9-23.6 inches (20-60 cm). In the absence of predators such as pikeminnow, juvenile suckers use deeper water (Moyle 2002).	
water depth preference for juvenile rearing	Reported range of most frequently observed water depth utilization.		
cover preferences for rearing juveniles	Type of cover for protection from predators used by rearing juveniles (e.g. crevices, submerged aquatic vegetation, overhanging vegetation, substrate cover, undercover bank, small woody debris, large woody debris).	Sacramento sucker postlarvae emerge and are soon washed in warm shallow or among flooded vegetation, where they often occur in large aggregations (Moyle 2002).  Larval Sacramento suckers less than 0.6 inches (14 mm) SL concentrate over detritus bottoms or among emergent vegetation in warm, protected stream margins (Moyle 2002).	
food base of juveniles	Indicate primary diet components. Also indicate the diet changes, if any, as growth occurs.	In the Russian River, postlarval suckers with their terminal mouths and short digestive tracts were surface and midwater feeders on early instars of aquatic insects. As they transformed in juveniles, with subterminal mouths and long intestines, their food consisted mostly of diatoms, filamentous algae, and protazoans. Small juveniles ranging in size from 0.94-1.5 inches (24-38 mm) SL ate a wide variety of small organisms, as well as indigestible items such as sand grains, suggesting development of the bottom-browsing habits of adults. The bulk of their diet, and that of large adults, consisted of filamentous algae, diatoms, and detritus. Invertebrates constituted less than 20% of the diet. In suckers less than 3.5 inches (9 cm) long, cladocerans were most important. In Sacramento sucker ranging in FL from 4.3-	

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		8.7 inches (11-22cm), hydracarinid mites and blackfly larvae were important, in addition to algae (mostly diatoms) and other invertebrates (Moyle 2002).	
feeding habits of rearing juveniles	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder. Also indicate change of feeding habits growth occurs.	Juvenile suckers of less than 1.97 inches (50 mm) SL stay on or close to the bottom, foraging in shallow (depths of 7.9-23.6 inches [20-60 cm], slowly flowing water (less than 0.3 ft/sec [10 cm/sec]) along stream margins (Moyle 2002).	
predation of juveniles	Indicate which species prey on juveniles.	Centrarchid basses and pikeminnow prey on juvenile Sacramento suckers. In addition, young-of-year suckers are prey for trout on occasion. Larval suckers are typically abundant when fall-run juvenile chinook salmon are moving downstream and are often heavily fed upon by salmon. Otters, ospreys, bald eagles, and herons prey on Sacramento suckers (Moyle 2002).  Suckers of various species are important in the diet of bald eagles, presumably because their morphological and behavioral adaptations related to benthic feeding limit their ability to perceive attack from above (Vondracek et al. 1989).	
timing range for juvenile rearing	Range of time of year (months) during which rearing occurs.	In some spawning streams juveniles will spend 2-3 years in streams before finally moving down to a larger river or reservoir during high flows. In streams with resident populations of suckers, juveniles stay in shallow, dense cover as long as possible, as a haven from predators, especially centrarchid basses (Moyle 2002).	
timing peak for juvenile rearing	Time of year (months) during which most rearing occurs.	Juveniles remain in the streams during the summer and fall and move to the deeper waters of pools or lakes in the winter (Wang J. 1986).	
<b>Juvenile emigration</b>			
time spent in fresh water prior to emigrating	Duration (in years and/or months) from emergence to emigration to the ocean.	Sacramento sucker are potamodromous, migrating from large bodies of fresh water to streams for spawning (Wang J. 1986).  Postlarval and small juvenile suckers may move from spawning tributaries downstream to a large river or reservoir at lengths ranging from 0.4-1.2 inches (10-30 mm) FL. However, in some spawning streams, juveniles will spend 2-3 years in the spawning stream prior to moving downstream to a large river or reservoir during high flows (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
water temperature tolerances during emigration	Range of water temperatures allowing survival. Indicate stressful or lethal levels.		
water temperature preferences during emigration	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
emigration timing range	Time of year juveniles commence emigration and duration of emigration.	Emigration from rearing creeks to Sacramento River. In Thomas Creek there was a mass exit of postlarval and small juvenile suckers (0.4-1.2 inches [10-30 mm]) FL in a 3-week period in May, but larger juveniles (2.3-3.5 inches [59-90 mm]) FL moved down to the Sacramento River in small numbers continuously as long as flows were high enough to permit it (Moyle 2002).	
emigration timing peak	Time of year most juveniles are emigrating.		
size range of juveniles during emigration	Minimum and maximum sizes (inches or mm) of emigrating juveniles. Indicate average size.	Postlarval and small juvenile suckers may move from spawning tributaries downstream to a large river or reservoir at lengths ranging from 0.4-1.2 inches (10-30 mm) FL. However, in some spawning streams, juveniles will spend 2-3 years in the spawning stream prior to moving downstream to a large river or reservoir during high flows. In Thomas Creek, larger juveniles (2.3-3.5 inches [59-90 mm]) FL moved down to the Sacramento River in small numbers continuously as long as flows were high enough to permit it (Moyle 2002).	
factors associated with emigration	Pulse flows, water temperature changes, turbidity levels, photoperiod, etc.		
<b>Other potential factors</b>			
DO	Levels of dissolved oxygen in water expressed in mg/l tolerated by fish.		
pH	Alkalinity/acidity of water (expressed in pH) that fish can tolerate.		
turbidity	Indicate turbidity or state of water (e.g., clear water or presence of siltation or organic/inorganic matter in water) that fish can tolerate.		

Element	Element Descriptor	General	Feather River Specific
factors contributing to mortality	e.g. fishing/angling mortality, drastic habitat alterations, unfavorable climatic changes, etc.		

## References

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